as ptomaïnes, and produced by the growth and activity of putrefactive bacteria in media containing proteids. Brieger ("Die Ptomaine," Hirschwald, Berlin, 1885) has published a most important series of observations on the production, nature, and action of ptomaines, and has greatly enlarged our knowledge of this as yet obscure subject. The description of the symptoms observable on persons inoculated by Ferran (as given by a variety of independent witnesses and by Ferran himself), can leave little doubt that the result of these inoculations is septic poisoning, in severe cases dangerous phlegmon and ulceration, and even death. This is also the opinion of a number of medical men (Spanish, English, and French) who have had the opportunity of seeing and examining such persons, as will be seen from the Report by the Special Commissioner of the *British Medical Journal*, the Report by the Special Commissioner of the *Times*, the Report by the Special French Commission, and the Report of the Commission sent by the Spanish Government. Such being the case, the inoculations practised by Ferran and his coadjutors can have no possible prophylactic effect against cholera, even granting, for the sake of argument, that one mild attack of cholera protects against a second severe one, a question which is still *sub judice*, since some competent authorities maintain that such immunity, although holding good in a number of infectious maladies, does not apply to cholera.

4. Now, are persons inoculated by Ferran furnished with immunity against an attack of cholera? The statistics published by Dr. Ferran and his adherents on the marvellous effects of inoculation in Alcira, Valencia and other places, accepted by Dr. Cameron in his article above referred to, show us a picture of brilliant successes, favourably comparing and even surpassing the statistics of the effect of vaccination against smallpox. Those statistics collected by Ferran being endorsed by several medical men and other notabilities of the town of Alcira and elsewhere, Dr. Cameron cannot bring himself to regard as not revealing the truth; he cannot imagine that all these worthy people should conspire to pervert the truth and to prevent the truth from becoming known.

The correspondent of the *Times* in his letter, published October 20, gives a long list of places where the statistics published by the Ferranists are signed and stamped by the Alcalde of the place, the local judge, the priest, the resident doctors, and the notary; all duly signed and stamped. This Englishman, however, probably knowing what value to attach to the competency and veracity of all those worthies, examined the statistics for himself, and the result of his inquiry may be briefly summarised by saying that Dr. Ferran and his partisans have simply "cooked" those statistics. They have done these things: when a person who had been inoculated by Ferran did nevertheless become affected with cholera, and died of it, death was put down as caused not by cholera but by some other disease; false entries were made as to persons who, having been inoculated, nevertheless died of cholera, were not entered as having been inoculated; persons have been registered as having been "vaccinated" by Ferran, but on inquiry were found to have died of cholera several days previous to the alleged "vaccination."

Add to this the fact that in Alcira, for instance, the inoculations and their wonderful effects had not commenced until the population had abandoned the impure water supply; that in some places many of the inoculated persons belonging to the well-to-do classes (a fee being paid for the inoculation) were therefore less exposed to infection, and those statistics become a gross farce and a shameless imposture. And this is practically the opinion of the Special Commission sent by the Spanish Government; this Commission has reported altogether unfavourably on these inoculations, declaring them barren of all scientific value, dangerous inasmuch as persons inoculated and suffering in consequence from a form of septic poisoning become more susceptible to infection from cholera and other diseases, and further condemning them as of no value in giving immunity against cholera.

The fact that Dr. Ferran and his associates took payment for the inoculations—thousands of persons were inoculated and reinoculated in Valencia and elsewhere, for each inoculation a fee of from 5 to 12 francs being charged—gives to the whole business a very ugly look. The *Times* correspondent (*Times*, October 20) does not therefore fully express the real value of Dr. Ferran when he says that he (Dr. Ferran) "is the dupe of illusions, conceived in ignorance."

E. KLEIN

## *LIFE OF SIR WILLIAM ROWAN HAMILTON*

*Life of Sir William Rowan Hamilton, Royal Astronomer of Ireland.* By Robert Perceval Graves, M.A., Sub-Dean of the Chapel Royal. Vol. II. pp. 719. With Portrait. (Hodges, Figgis, and Co.)

IN a former number of this journal it was our duty to notice the first volume of the life of the illustrious Irish mathematician. We have now to congratulate Mr. Graves on the completion of the second instalment of that great work which has evidently been to him a labour of love. This volume, like its predecessor, bears abundant testimony to the conscientious manner in which the author has sought to delineate a picture of Hamilton, told as far as possible by the letters from Hamilton to his friends and by extracts from his journal. We are again surprised at the extraordinary copiousness of the materials which were available.

The incidents in the life of Hamilton apart from his literary and scientific activity are but few. The last volume conducted us to the year 1832, when Hamilton was in his twenty-seventh year. We had there seen the troubled course of his two earlier love affairs, and at the outset of this volume we are introduced to the third with Miss Bayly, to whom he was married in 1833. His domestic happiness was in the course of years clouded over by the ill-health of his wife, though to the end he remained an attached husband, as she was an attached wife; two sons and one daughter were the issue of this union.

The reader of this work can hardly fail to be struck with the number and the worth of the friends to whom Hamilton was endeared; he possessed to a remarkable degree the power of transforming a casual acquaintanceship into a true and lasting friendship. His intimacy with Wordsworth has been already referred to, and was carried on by occasional letters and visits until the death of the poet. Among his other literary friends we may mention Maria Edgeworth, who writes to him (p. 384):—

"Take your head from the stars or from transcendental mathematics and come and enjoy Folly and Friendship."

There are also copious letters to and from Aubrey De Vere, Lord Dunraven, the Marquis of Northampton, and many others, including not a few to his intimate friend the author of the present work; one of these we would specially mention (p. 357), in which Hamilton sketches the obligations of true friendship. The scientific correspondence of Hamilton with many of the leading philosophers of the last generation occupies, as might have been expected, a large proportion of the volume.

At successive meetings of the British Association Hamilton was a well-known and a conspicuous figure. When the Association visited Dublin in 1835 he was but thirty years old, yet he had already attained a scientific renown which made him perhaps the most eminent man at that meeting. It was on this occasion that the Board of Trinity College entertained the distinguished visitors at a banquet. The guests had assembled in the venerable library of the University. The Earl of Mulgrave, then Lord Lieutenant of Ireland, called Hamilton to the centre of a little circle, and, after conferring upon him the honour of knighthood, said:—

"I but set the Royal, and, therefore, the national mark on a distinction already acquired by your genius and labours" (p. 158).

In speaking at the banquet subsequently, Whewell said, in language which the enthusiasm of the moment might perhaps excuse:—

"It was now one hundred and thirty years since a great man in another Trinity College knelt down before his Sovereign and rose up Sir Isaac Newton" (p. 159).

In the year 1842 Sir R. Murchison, then general secretary of the Association, writes to Hamilton as follows (p. 387):—

"Your letter of the 16th having crossed mine, *I am in despair* at your resolution not to visit Manchester; and in order to shake it if possible, even at the eleventh hour, I enclose you a letter from Herschel, whose resolutions were quite as firm as yours, and who yet has made them fly before Bessel. Think of this philosopher coming on purpose to see such men as Herschel, yourself, and two or three others, and finding Airy and Baily flown to Italy and Sir William Hamilton *lecturing* in Dublin!! Pray put off your class for a week. Make a noble effort and lay it all on Bessel's shoulders, and you will add to your glory."

On this occasion Hamilton had also the gratification of meeting the great mathematician Jacobi, who, after referring to Hamilton as the "Lagrange of your country," said (p. 388):—

"Provided that we give to the dynamical equations that remarkable form under which they have been presented for the first time by the illustrious Astronomer Royal of Dublin, and in which they ought to be presented hereafter, in all the general researches of analytical mechanics."

We also read how Hamilton was received at the Oxford meeting in 1847, in which, to quote his own words from a letter to the author, he says (p. 585):—

"It has several times happened to me to sit between Struve and Le Verrier (both of whom, somewhat to my surprise, and certainly beyond my deserts, assigned to me a high place among British astronomers in their speeches at the concluding meeting). And when I rose to give an account of the application of the calculus of quaternions to the theory of the moon on the Thursday of last week, and saw before me not only those two eminent foreign astronomers, but also Herschel, and Airy, and Adams, and Challis, besides Peacock and Whewell, and others scarcely less distinguished, I could not refrain from acknowledging it to be an alarming and almost an awful thing to speak on any subject of physical astronomy in the presence of such an audience."

Hamilton also records in an unsent letter the following, which refers to the same meeting (p. 585):—

"My friend Struve, of Russia, at Oxford, 1847, said: that, though I held the title of Royal Astronomer of Ireland, my astronomical brethren on the Continent would decidedly prefer my never looking through the telescope to my giving up or less ardently pursuing mathematics. 'You are,' he was pleased to say, 'our teacher.'"

Hamilton was for many years not only the most distinguished member of the Royal Irish Academy but also its president. Many interesting letters will be found in the volume relating to his election to this distinguished post. His rival, if so he can be called in what Hamilton describes as a "contest of generosity," was the late Provost Lloyd. Lloyd retired in favour of his friend, and Hamilton writes many letters, the character of which is fairly represented by one to Lloyd (p. 218), in which he disclaims

"Entertaining *even a thought* which could be construed into *treason* to our long and unclouded friendship, and that the part *you* have taken (while in some respects it adds to my pain) furnishes a new proof of the justice of the high opinion that I have ever entertained of you."

Hamilton discharged in the most exemplary manner the laborious duties of President for several years, until, as he writes (p. 510):—

"The day has at length arrived when I am to accomplish my desire of retiring from the chair of the R.I.A. How joyously, though not without a feeling of solemnity, I received the news of my being elected to the chair; how gladly now I resign it, yet not without a shade of that sadness which belongs to a farewell!"

The chief interest in this volume will be found in the account of the great invention of quaternions, with which the name of Hamilton will be for ever associated. His own appreciation of the importance of this achievement is shown in an extract from a letter to Prof. Lloyd in December, 1851 (p. 445):—

"In general, although in one sense I hope that I am actually growing *modest* about the quaternions, from my seeing so many peeps and vistas into future expansions of their principles, I still must assert that this discovery appears to me to be as important for the middle of the nineteenth century as the discovery of Fluxions was for the close of the seventeenth."

The account of the discovery which, after fifteen years of studious meditation, seems suddenly to have flashed upon Hamilton is told in an interesting letter written from his deathbed many years later to his son Archibald (August 5, 1865), p. 434:—

"On the 16th day of October, 1843, which happened to be Monday, and a council day of the Academy, I was walking in to attend and preside, and your mother was walking with me along the Royal Canal, to which she had perhaps driven; and although she talked with me now and then, yet an *undercurrent* of thought was going on in my mind which gave at last a *result*, whereof it is

not too much to say that I felt *at once* the importance. An *electric* circuit seemed to close; and a spark flashed forth, the herald, as I *foresaw immediately*, of many long years to come of definitely directed thought and work, by *myself* if spared, and at all events on the part of *others*, if I should even be allowed to live long enough distinctly to communicate the discovery. Nor could I resist the impulse, unphilosophical as it may have been, to cut with a knife on a stone of Brougham Bridge, as we passed it, the fundamental formula with the symbols $i, j, k$;—namely, $i^2 = j^2 = k^2 = ijk = -1$, which contains the *solution* of the *problem*, but of course, as an inscription, has long since mouldered away. A more durable notice remains, on the council books of the Academy of that day—October 16th, 1843—which records the fact, that I then asked for and obtained leave to read a paper on *quaternions* at the *first general meeting* of the session, which reading took place accordingly, on Monday, November 13."

Among the most distinguished disciples of Hamilton is Prof. Tait, though *even he* has admitted that he has not read the whole of Hamilton's "tremendous volumes" (lives there indeed the man who has?). Another account of the discovery is found in a letter to Prof. Tait on October 15, 1858 (p. 435):—

"To-morrow will be the fifteenth birthday of the quaternions. They started into life full-grown on the 16th of October, 1843, as I was walking with Lady Hamilton to Dublin, and came up to Brougham Bridge—which my boys have since called Quaternion Bridge. I pulled out a pocket-book, which still exists, and made an entry, on which *at the very moment* I felt that it might be worth my while to expend the labour of at least ten or fifteen years to come. But then it is fair to say that this was because I felt a *problem* to have been at that moment *solved*, an intellectual want relieved which had haunted me for at least *fifteen years before*."

The unmathematical reader may naturally ask the nature of this notable discovery which Hamilton made at "Quaternion" Bridge.

It would seem that at this moment he solved the long-studied problem of the multiplication of directed straight lines, or vectors as he called them. Let $a$ denote a straight line of determined length and direction. Let $b$ denote another straight line at right angles to $a$, and radiating from the same origin; then the product $ab$ denotes a third straight line from the same origin perpendicular to the plane of $a$ and $b$; the product $ba$, however, denotes the perpendicular line on the other side of the plane, so that $ba = -ab$. This formula is eminently characteristic of the method, showing as it does that vector multiplication is non-commutative. It is, however, remarkable that the associative principle obtains in quaternions no less than in ordinary algebra; thus if $a, b, c$ be three vectors, or more, generally quaternions, then $ab \times c = a \times bc$. This theorem, though *true* in quaternions, is still so far from being obvious that it implies the truth of an elaborate geometrical theorem.

If we could single out one point of special significance in the invention of quaternions it would be found in the *dual* interpretation of the symbol of a vector. Thus if the letter $i$ denotes a vector or directed straight line of unit length, then the same symbol may also mean an operation of rotation through a right angle around the vector as an axis. In the formulæ of quaternions the symbols denoting vectors can be interpreted in this dual manner. A quaternion may be regarded as the operating factor which applied to one vector transforms it into another. This operation requires two quantities to specify the plane of the vectors—one to specify the angle between them and one the ratio of their lengths in all four quantities are required, whence the name quaternion.

An interesting letter (p. 536) to the Rev. John W. Stubbs, Fellow of Trinity College, dated October 19, 1846, gives a sketch of the points which Hamilton thought specially novel in his theory:—

"But did the thought of establishing such a system, in which *geometrically opposite factors*—namely, two lines (or areas) which are opposite IN SPACE give ALWAYS a *positive product*—ever come into anybody's head, till I was led to it in October, 1843, by trying to extend my old theory of algebraic couples, and of algebra as the science of pure time? As to my regarding *geometrical addition* of lines as equivalent *to composition of motions* (and as performed by the same rules), that is indeed *essential* in my theory, but *not peculiar* to it; on the contrary I am only one of many who have been led to this view of addition."

A few years later Hamilton commenced the delivery of lectures on quaternions in Trinity College. His own words are (p. 605):—

"It was on Wednesday, June 21, 1848, that I delivered my first lecture on quaternions to a very respectable audience, among the persons composing which were the Rev. George Salmon, Fellow of Trinity College, Dublin, and author of a lately-published treatise on Algebraic Geometry, and Arthur Cayley, Fellow of Trinity College, Cambridge, who first, except myself, has publicly used the quaternions."

These lectures, rewritten and greatly expanded, formed his first and classical volume—"Lectures on Quaternions." (Dublin, 1853.)

The publication of this work drew from Hamilton's many scientific friends cordial letters of congratulation. His old and intimate friend, Sir John Herschel, thus writes on July 21, 1853 (p. 681):—

"Now most heartily let me congratulate you on getting out your book—on having found utterance *ore rotundo* for all that labouring and seething mass of thought which has been from time to time sending out sparkles, and gleams, and smokes, and shaking the soil about you—but now breaks into a good honest eruption with a lava stream and a shower of fertilising ashes. I don't mean to say that there is not a good deal of cloud (albeit full of electric fire)—the good old 'stupendo e orgoglioso pino' of the fiery outbreak surrounding the bright jet, the true product—but the cloud clears as the wind drifts and leaves the hill conspicuous.

"Metaphor and simile apart, there is work for a twelve-month to any man to read such a book, and for half a lifetime to digest it, and I am quite glad to see it brought to a conclusion."

The intercourse, both social and scientific, between Hamilton and Sir John Herschel gives many interesting pages to this volume. Thus, for instance, we find (p. 492) an account of a meeting between these philosophers at the house of their common friend, Dr. Peacock, the Dean of Ely. On Sunday they attended service in the Cathedral in company with Prof. James D. Forbes, and Hamilton recorded the incident in a sonnet which he recited to his friends. The next morning he received an acknowledgment in kind from Herschel. We quote here the two poems: that of Hamilton (p. 493) bears the title "In Ely Cathedral":—

"The sunshine, through the lofty window stealing,
Lit up that vast and venerable fane,
Ely's Cathedral, in dark clouds and rain
Wrapped lately, and shut up from joyous feeling:
In its soft progress all around revealing
Beauty or majesty unmarked before,
It shed its type of heavenly comfort o'er
Three kindred-kingdoms' sons together kneeling.
Oh, may that Church, Episcopal and pure,
One Mother of that kneeling company,
In essence one, in name and office three,
Mid outward storm and darkness still endure:
Be comforted of Christ in God's good time,
And share the sunshine of a heavenlier clime."

Herschel's sonnet in reply (p. 494) was handed to Hamilton the following morning:—

"ON A SCENE IN ELY CATHEDRAL

"The organ's swell was hushed, but soft and low
An echo, more than music, rang; when he,
The doubly-gifted, poured forth whisperingly,
High-wrought and rich, his heart's exuberant flow
Beneath that vast and vaulted canopy.
Plunging anon into the fathomless sea
Of thought, he dived where rarer treasures grow,
Gems of an unsunned warmth and deeper glow.
Oh! born for either sphere! Whose soul can thrill
With all that Poësy has soft or bright,
Or wield the sceptre of the sage at will
(That mighty mace which bursts its way to light).
Soar as thou wilt! or plunge—thy ardent mind
Darts on—but cannot leave our love behind."

We have introduced these verses not so much on account of the poetical merit they possess, which we confess appears to us to be but slight. They may, however, serve as samples of those poetical effusions with which these volumes teem—indeed they give the impression that there must be some occult sympathy between poetry and astronomy. It is well known that Romney Robinson was a poet, and though it does not appear that Sir George Airy had plunged into verse, yet when he and Hamilton were together at Parsonstown there was an amusing contest between the two Royal Astronomers as to which could repeat most English poetry. The present writer has heard this scene described by the late Earl of Rosse, who said that Sir G. Airy was admitted to have carried off the honours.

As an illustration of one of the less important mathematical labours of Hamilton we may mention his paper on the Hodograph, communicated to the Royal Irish Academy in 1846. This elegant conception is a curve whereof the radius vector to any point from the origin represents both in direction and in amount the velocity of a moving particle. Many interesting applications were made by Hamilton, and are referred to in correspondence with Whewell. A somewhat ludicrous incident in connection with the hodograph is recorded (p. 543). It appears that at the same meeting of the Academy in which the hodograph was discussed, Hamilton also exhibited Prof. Mädler's just published work on "The Central Sun." This precarious speculation was by the reporter injudiciously blended with the hodograph, and an astounding statement went the round of the papers asserting that Hamilton's wonderful calculus had succeeded in discovering the central point of the universe!

It is not, perhaps, generally known that the real discoverer of the hodograph was Bradley (see Rigaud's edition of Bradley's Memoirs, Oxford, 1832, p. 288). Bradley has there given a most elegant geometrical investigation of that circle related to elliptic motion which Hamilton afterwards named the hodograph.

The religious side of Hamilton's character demands a few words of notice. He was a member of the Establishment, and many passages show that he had the sympathies of a sound churchman. He seems to have been an admirer of Pusey, with whom he was also personally acquainted. We also find occasional reference to the midnight vigils with which he awaited the new year, and to the fasting which he sometimes practised for devotional reasons. We should imagine, however, that such exercises were but very occasional to a student so laborious yet so irregular as Hamilton.

He found time to be president of a local branch of the Society for the Propagation of the Gospel. He assumed the duties of a churchwarden, and vanquished Archbishop Whateley in a controversy on the orthodoxy of an inscription on the church window at Castleknock. At Whitsuntide we find him writing a dynamical theory of the ascension of our Lord, in which in mediæval fashion he proceeds to evaluate the *duration* of the phenomenon, which he demonstrates to have been less than the interval between Holy Thursday and Whit Sunday.

It is with evident pain that the biographer has felt himself compelled to record the one great failing of his illustrious friend. The excessive devotion of Hamilton to study and the engrossing nature of those mathematical reveries in which he indulged led to the formation of very irregular habits. He "too often found the dawn surprise him as he looked up to snuff his candles after some night of fascinating labour." The necessary hours for rest and refreshment being disregarded, he was led to the dangerous practice of an undue recourse to alcohol, and occasional intemperance was the consequence. Two or three scenes arising from this cause have been described in this volume. There is one which can hardly have been witnessed except by the biographer himself, but which his conscientiousness has compelled him to record. There is a second on a public occasion which caused the deepest grief to Hamilton's friends, one of whom called upon him with a kind remonstrance which was received by Hamilton in a manner worthy of his high character. There is also a third incident, perhaps the most painful of all, which illustrates the attempt of Hamilton to reform and the circumstances under which he relapsed.

We certainly have no intention of citing these passages in this place, for if torn from their setting in the life of this great man they would probably convey an exaggerated notion of the extent of his infirmity. We would rather record the words of Mr. Graves, where he says (p. 335):—

"It is mournful that what seems to have been an inconsiderate, and at first unconsciously indulged, defect in external regimen of life, for such in the inception was his infirmity, should avail to cast a shade over qualities so solid and so splendid as the moral and intellectual qualities of Hamilton."

We have still to look forward to the third and concluding volume of this important work. In it we are to read how Hamilton continued his stupendous labours which culminated in the appearance of his other great work, the "Elements of Quaternions." We are also

promised that extensive correspondence with De Morgan, which will secure the attention of every lover of the "Budget of Paradoxes." At the close of our former notice we insisted on the duty which devolved on the University of Dublin of publishing in a collected form the mathematical writings of their illustrious son. This duty has not yet been discharged; let us hope that it will not be left to some foreign mathematician to undertake the work which it should be the glory of Trinity College to complete.

## AN AGRICULTURAL NOTE-BOOK

*An Agricultural Note-Book.* By W. C. Taylor, Aspatria, Carlisle. (London: Longmans, 1885.)

IT is not often that note-books are published, and it is well. Notes are in their nature fragmentary, and disposed towards brevity, often lapsing into crudity. They are a sort of skeleton of imparted knowledge, or at least rather anatomical than living, moving, and breathing information. The least and the most that may be reasonably expected of them is that they should be correct. The small book which has just been published by Messrs. Longmans does not commend itself to our judgment. It is crude, fragmentary, and almost inarticulate or unintelligible. It purports to contain a body of teaching and of facts, but it really consists of disjointed sentences, the meaning of which it is often very difficult to gather. The grammatical construction of the sentences is also fearful and wonderful. To give an idea of this latest contribution to agricultural science, we select the opening passage, page 1, which reads as follows:—"The science of agriculture. Definitions and terms. Its definitions. Scientific truths taught by the practice of agriculture." "The practice of the farm teaching the science. The laws of agricultural science best learnt when thus taught, and lead to improvements in the application of science to farm practice." If this is a definition, much has been written in vain as to the difficulty of defining. It not only fails in definiteness, but is curiously involved, as well as untrue, for "the practice of the farm teaching the science" is an impossible and impracticable idea.

The word "its" before each paragraph of definitions and terms appears to bear reference to the general heading, "The Science of Agriculture," and cannot be supposed to bear a grammatical relation to "definitions and terms." Taking this view of Mr. Taylor's "notes," we read as follows:—

"Its character in the soil, as temper, will, and disposition. These to be noted: success of farmer depending much on his knowledge of above (sister sciences). *Hungry, sick, grateful, obstinate, kindly, tender*, &c."

We defy any one to make any sense out of these utterances, whether taken with or without their context.

Next we have an attempt at further amplification. Thus "1 HUNGRY—constantly in want of food." Now, be it remarked that the subject is *soils*, and we are told that a soil is "hungry, constantly in want of food." Also that it is "sick." Here is indeed confusion of metaphor and blind guiding with a vengeance. Only let readers of NATURE endeavour to picture to their minds a hungry and sick soil! No wonder that Mr. Taylor in the richness of his fancy can further enlarge upon its gratitude, tenderness, and kindliness. Page 1 would itself furnish ample matter for review. It is as full of difficulties as the Moabitish stone, although it might so well repay deciphering.

Again we read: "Short supply of organic matter improved by adding clay, where practicable, and vegetable matter." While concurring with the last simply-given advice as remedying the fault in question, we deny that any amount of clay can help towards this end.

Turning p. 1, we come to p. 2, where we begin at the top as follows:—"3. TENDER.—Hard and baked. Improved by rain, drags and harrows at right time." This tender soil is then hard and baked, and it appears also that it is improved by certain natural and artificial agencies which we thought were not only and solely unfit for the amelioration of such tender, albeit hard and baked soils.

On the same page we are thus enlightened as to the primitive rocks:—"The primitive rocks differ from materials yielded by decay, which is accomplished by oxygen (O) and carbonic acid ($CO_2$), gases invisible and transparent. Both attack rocks and metals, however hard; seen in the mould-board of the plough reducing it (?) to a powder without noise. *Temperature* and *water*, other two *agents* acting on the *Traitor's iron* and *potash*, loosening particles from the hard rock." . . . . These agents are the *friendly helpers* to the farmer. The italics are Mr. Taylor's own. We are irresistibly reminded of Mr. Weg and Mr. Venus, those two "friendly movers" in "Our Mutual Friend."

Passing onwards through the dreary succession of sentences devoid of subject, predicate, or copula, we arrive at p. 12, where instruction is given upon the various component parts of soils. Here we find the following information regarding alumina:—"Alumina. (1) Present in the soil, but not in plant food. (2) Double silicates are (1) silicate of alumina, (2) (*a*) lime, (*b*) potash, (*c*) or of soda, (*d*) or of ammonia. (3) Order of compounds, $H_3N_1K_2CO_3$, $Na_2CO_3$. The higher favourite puts out a lower and unites with the silicate of alumina. (4) The powers of vegetable life command an influence over each and all the second-rank partners. (5) Performs work of outdoor servant. (6) Reconstructs broken-up partnerships. (7) Amidst the faithless, constant only she. (8) Acts as purveyor of food for the plant."

We leave this extraordinary statement of the eight duties of alumina in the soil to the judgment of any sound scientific man or agriculturist, asking only why young people should be subjected to teaching so completely misleading, erroneous, and unintelligible, on the plea that they are obtaining insight into the principles of agricultural science?

## THE PREVENTION OF BLINDNESS

*The Causes and the Prevention of Blindness.* By Dr. Ernst Fuchs, Professor of Ophthalmology in the University of Liége. Translated by Dr. R. E. Dudgeon. 8vo, pp. 230. (London: Baillière, Tindall, and Cox, 1885.)

UNDER the title of "The Causes and Prevention of Blindness," Dr. Dudgeon has translated an essay, written by Dr. Fuchs, of Liége, under the conditions of a